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# BIOLOGICAL BULLETIN

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## PATHOLOGICAL AMITOSIS IN THE FOOD-OVA OF FASCIOLARIA.<sup>1</sup>

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In his paper entitled "Amitosis in the Embryo of *Fasciolaria*" ('04), Professor H. L. Osborn has described the nuclear changes occurring in the food-ova with which the embryos of *Fasciolaria tulipa* gorge themselves at a certain stage of their development ('05). Since the appearance of Child's paper ('07) will no doubt stimulate fresh interest in direct nuclear divisions, I have decided to publish this note on pathological amitosis, particularly as Professor Osborn's description is unsatisfactory. Not only has he conceived an erroneous idea of the structure of the nuclei in

question, but he has failed to point out the lesson which they teach, for nuclear divisions which have in common only the property of being non-mitotic, are for that reason not necessarily comparable in other respects.

The germinal vesicles of the food ova, placed excentrically in the eggs, surrounded by a zone of cytoplasm comparatively free from yolk granules, are surprisingly large. The only regions of these vesicles that stain are the

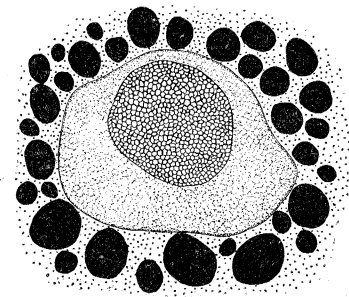


FIG. 1. Unfragmented germinal vesicle of food ovum. The large black bodies represent yolk.

enormous nucleoli in which the chromatic material is located between the bubbles of a fine non-staining froth. Outside of each nucleolus, the nuclear material is composed of minute granules

<sup>1</sup> Contributions from the Zoölogical Department, University of Michigan, No. 109.

which in the preserved specimens studied have the appearance of a more or less definite reticulum suspended in a homogenous ground substance. The vesicles are bounded by a definite membrane outside of which is granular cytoplasm with large yolk spheres. It is quite evident from the legend beneath Fig. 6, p. 875, of Professor Osborn's paper ('04) that he misinterpreted what he saw, for he figures the germinal vesicle alone, and says that

it is "The nucleus and the immediately adjacent cytoplasm," mistaking the nucleolus for the nucleus, and the non-staining portion of the vesicle for cytoplasm.

After the food ova have been ingested a number of days, the germinal vesicles fragment, and the appearance which they present at that time is much as though they had exploded. Instead of finding a single nucleus, one sees numerous fragments, varying greatly in size, and in each case, miniatures of the original germinal vesicle. Each fragment has a central mass, frothy in structure, and staining deeply in the spaces between the bubbles — a piece of the original

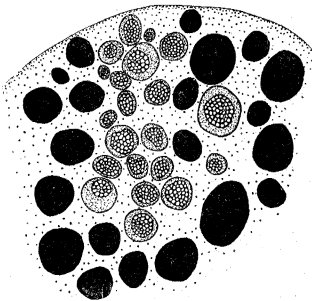
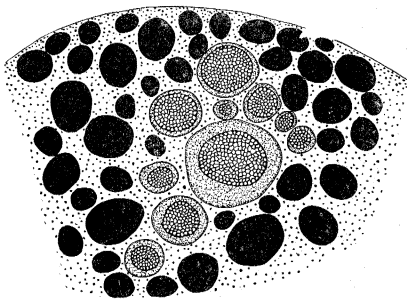


FIG. 2. Fragments of two germinal vesicles. The large black bodies represent yolk.

nucleolus. Surrounding this stained region, is a clear zone of finely granulated nuclear substance bounded by a definite membrane. In some cases the "nucleoli" of these fragments are irregular, but usually their outlines are oval and smooth.

I have not been able to find the elongated dumb-bell shapes described by Osborn ('04, Fig. 7), and interpreted by him as late stages in amitosis; neither have I succeeded in satisfying myself that such intermediate stages as my material shows, are common

transition stages between the unfragmented and the fragmented nuclei for not only are these intermediate stages very rare, but they are unconvincing when found, and the appearance which the fragmented vesicles generally present suggests that the divisions took place quickly, perhaps by explosion. I have, however, in a few cases seen constrictions in several of the fragments as though these were undergoing one or more fissions (Fig. 3).

Besides showing several cases of what may be fission, Fig. 3 illustrates two other degenerative changes which occur when the ova are about to disintegrate. Frequently large vacuoles are found inside of the "nucleoli," in some instances apparently bursting outward into the nucleoplasm, somewhat as the vacuoles in the external kidneys do ('05). These vacuoles in the "nucleoli" seem to originate from the bubbles of the chromatic froth but of this I am not certain. The other degenerative change is the presence in a few instances of small densely staining masses to which Osborn ('04) has drawn attention, and which he compared to the "spore-like bodies" described by Herrick ('92) in the degenerating nuclei of the yolk

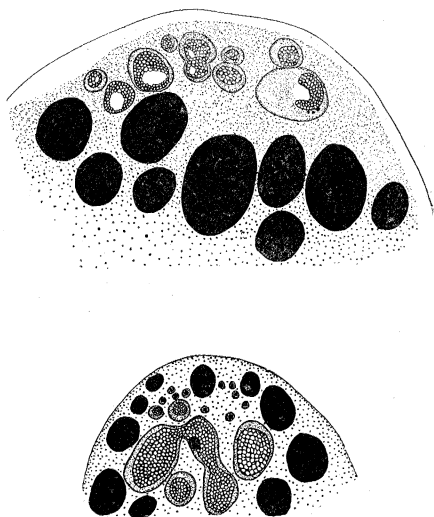


FIG. 3. Fragments of two germinal vesicles showing "spore-like bodies" in upper right hand fragment; vacuoles in the "nucleoli"; and what may be cases of fission. The large black bodies represent yolk.

cells in the egg-nauplius of *Alpheus*. These bodies I believe are condensations of the chromatin, and they may be found lying either in the "nucleolus," or outside it in the nucleoplasm.

In concluding his section on the nuclear phenomena in the food ova, Professor Osborn says: "The cells in which the nuclei have undergone these changes are on the road to complete breakdown, and these changes are the last events in their lives. The process is a futile attempt at segmentation where normally we

should find mitosis, but in this case the cell having the impulse to divide, but being powerless to do so by mitosis, falls back on the easier mode and does so by amitosis." That the food ova "are on the road to complete breakdown" is unquestionably true, but that the nuclear activities described should be looked upon as futile attempts at segmentation, involving the substitution of amitosis for mitosis, seems to me in the highest degree doubtful. The ova of *Fasciolaria* that develop, are fertilized before maturation, and as the food ova are not fertilized ('05) and consequently not matured, attempts at cleavage are hardly to be expected. Among the conditions to which the eggs are subjected, it is conceivable that they might find stimuli to mature without impregnation, but the nuclear phenomena actually observed are so utterly different from any of the other known kinds of nuclear division, that to interpret the process as a futile attempt at either maturation or segmentation, is to blind oneself with metaphor. To include without qualification such phenomena as these under the heading "amitosis," especially if it becomes established, as seems likely, that under natural circumstances, direct nuclear divisions may intervene between mitotic divisions without wrecking the ability of the cell to have progeny capable of further differentiation, is certainly inexcusable. It may be etymologically correct to say that a nuclear division other than a mitotic one, is amitotic, but to him who has formed an idea of direct nuclear division from its more usual forms, the word "amitosis" would certainly not suggest Fig. 2 of the present paper. It will be necessary in the future to keep separate the normal and the abnormal events in this field, and to distinguish physiological from pathological amitosis.

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ANN ARBOR, February 25, 1907.

#### REFERENCES.

**Brooks, W. K., and Herrick, F. H.**

'92 The Embryology of the Macroura. Mem. Nat. Acad. Sci., V.

**Child, C. M.**

'07 Studies on the Relation between Amitosis and Mitosis. Biol. Bull., XII.

**Glaser, O. C.**

'05 Ueber den Kannibalismus bei *Fasciolaria tulipa*, etc. Zeitschr. f. w. Zool., LXXX.

**Osborn H. L.**

'04 Amitosis in the Embryo of *Fasciolaria*. Amer. Nat., XXXVIII.